

# Integration Checker of JAVA P2P distributed System with Auto Source Code Composition

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**Abstract.** This paper presents an integrity checker of JAVA P2P distributed system with auto source code composition. JAVA distributed system must guarantee the integrity of program itself and the system components of JAVA virtual machine against attackers, hackers, spies, cheaters, conspirators, etc. There are lots of trusted computing methods to guarantee the integrity of the system. We here present a novel method using just-in-time auto source code composition to generate auto-check class for integrity measure and encrypt of integrity reporting. By companies' effort, we have implemented and use it in DSCLoud platform.

**Keywords:** Trusted Computing, Distributed System, Integrity Checker , Auto Source Code Composition, Cybercrime

## 1 Introduction

Distributed systems involve many hardware and software components as well as many users who use the systems. To guarantee the correct results of distributed computing and the trusted access of information against attackers is vital important issue. Trusted Computing (TC) developed and promoted by the Trusted Computing Group[1] provides strategies to solve the above problem from hardware and software aspects. With Trusted Computing enforced by computer hardware and software, the computer behaves in expected and trustful ways. Systems based on Trusted Computing can protect critical data and systems against a variety of attacks, enable secure authentication and strong protection of unlimited certificates, keys, and passwords that otherwise are accessible, establish strong machine identity and integrity, help satisfy regulatory compliance with hardware-based security, and so on. The technologies of Trusted Computing provide more secure remote access through a combination of machine and user authentication, protect against data leakage by confirmation of platform integrity prior to decryption, provide hardware-based protection for encryption and authentication keys used by stored data files and communications (email, network access, etc), protect in hardware Personally Identifiable Information, such as user IDs and passwords and protect passwords and credentials stored on drives[1].

P2P technologies currently are used to construct distributed systems. P2P has been widely used in file sharing, instant message, telephone communications, etc. But, it is difficult to construct distributed systems like distributed operating systems. There are two kinds of P2P technologies. The un-structural P2P technology such as Freenet[2] using flooding way has shortage of heavy traffic and un-guaranteed search. The structural P2P technology using DHT such as Chord [3] and Pastry [4] loses semantic meanings. Semantic P2P networks ( virtual hierarchical tree Grid organizations(VIRGO)) [5][6][7] can avoid the above disadvantages . We use semantic P2P networks to construct distributed system ( DScloud )[8] which can do distributed search, parallel computing, etc.

JAVA is a programming language that is intended to let application developers "write once, run anywhere" and can run on all platforms that support Java virtual machine. With JAVA, code mobility is also very easy to be implemented. In distributed systems, in many cases , we need the processes of moving mobile codes across the nodes of a network. JAVA P2P distributed systems involve many heterogenous environments and various people who are different interest. It is difficult to control users' behaves. In order to guarantee the correct results of computing and to avoid attacking by all kinds of attackers, in JAVA P2P systems, how to check the integrity of the programs becomes a vital important issue.

We here present an integration checker of JAVA P2P distributed System with auto source code composition . It is more safe than traditional security methods.

The structure of this paper is as follows: section 2 describes the purpose of integrity checker of distributed system; section 3 describes framework for integrity checker of JAVA distributed system; section 4 presents implementation of integrity checker in DScloud platform; section 5 analyzes the integrity check against attackers and finally we give conclusions.

## 2 The Purpose of Integrity Checker of Distributed System

For P2P distributed system, integrity checker of program is pre-requisite service. The purposes of integrity checker of distributed system are as the following:

### 1. against attacker to forge identification

In distributed systems forge identification can make the users believe the attackers are the forged users, which are harmful in instant message [9]or information retrieve. For example, some person is framed by user A who forges as user B with broadcasting false messages. Obviously, the person is harmed , and all people think user B broadcast the message. Obviously , wether the cheat is successful or not , all happens will be beneficial to user A , harmful to user B. If the integrity of program can not been guaranteed , the program can be changed to implement the forge identification very easily. As P2P distributed systems with so many users, this case may happen very often. In another case, the forge attacker can retrieve access control information of the other computers. If there

is no integrity checker, people are afraid to use the program even in the case that the company vows the system is safe.

### **2. against attacker to access the privacy data**

In P2P distributed systems the node computers have many privacy data. In the cases such as file sharing and local search engines[10], we must limit the file directories to share and retrieve. If the integrity of program can not been guaranteed , the program can be changed to enlarge the scope of the directories even covering all the file system, especially , when the program is developed by JAVA which can be easily decompiled and modified.

### **3. against attacker to mislead the wrong results**

In P2P distributed systems, the nodes are used to do parallel computing[11]. To guarantee of the integrity of program is most important. If the integrity of program can not been guaranteed , the program can be changed to mislead the wrong results of the computing. For example, We have implemented a distributed knapsack problem solution in our DScloud platform, in which sub knapsack problems will be sent to P2P nodes to compute. If the program in one of the nodes has changed, that will lead to get the wrong results.

## **3 Framework for Integrity Checker of JAVA Distributed System**

In a distributed systems developed by JAVA, integrity checker at least includes a minimum of three components similar described in [12]:

**1. Protected capabilities** program and its required Jars , and JAVA virtual machine environment .

**2. Integrity measurement** the process of obtaining metrics of platform characteristics that affect the integrity (trustworthiness) of a platform.

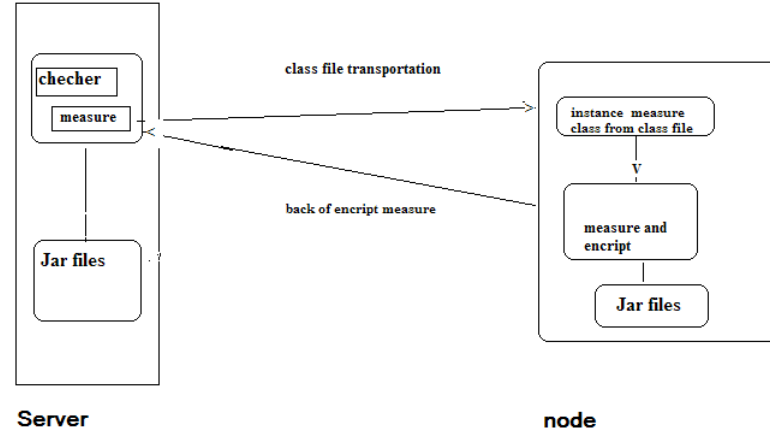
**3. Integrity reporting** (i) to expose properties of integrity measurements, and (ii) to attest to the integrity of the measured properties.

In P2P distributed systems which have NAT[13] servers to provide the out IP and port, the servers maintains the integrity properties of the programs. Fig 1. shows framework for integrity checker of distributed system we presented.

In the framework of the integrity checker, the measurement and encrypt methods are produced by generating just-in-time source codes and compiling by the server, and the program gets class file from server and dynamically invokes instance of object of the class. So, every time every user, the measurement tool and encrypt methods are quite different, this makes hacker impossible to bypass the integrity check process.

## **4 Implementation of Integrity Checker in DScloud Platform**

The DScloud platform is developed by Hangzhou Domain Zones technology Co., LTD and Hangzhou Domain Search Networking Technology Co., LTD.



**Fig. 1.** Framework for Integrity Checker of JAVA Distributed System

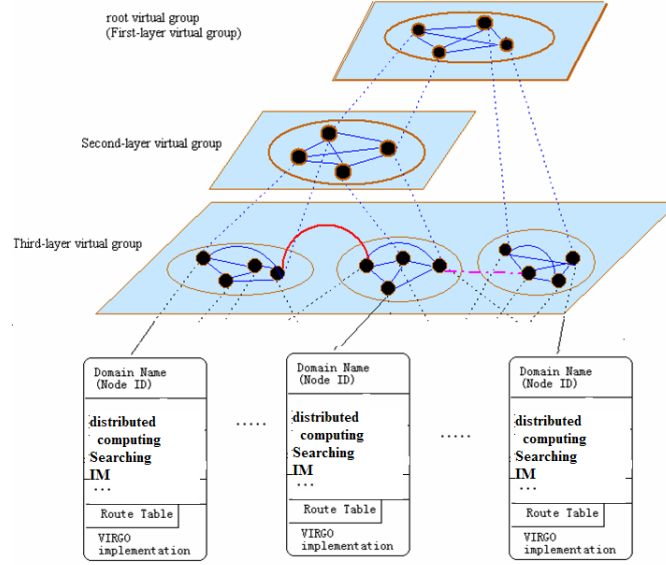
The DScloud platform is based on semantic P2P networks, which the nodes are virtually grouped as hierarchical classifications according to the semantic meanings as the fig.2 shows.

The DScloud platform includes one server program and many nodes' programs. The server program functions NAT server, and integrity check, and storage of mobile codes. The components of the DScloud platform are as fig.3 shows.

The AutoSource.jar includes Checker which checks the node's program. The checker includes auto source code composition which generates measurement tool and encrypt methods.

The integrity check protocol is as following :

- Step 1 node's program sp2pen.jar sends the autoCheck message which indicates the node ID to sp2psserver
- Step 2 sp2psserver receives the autoCheck message , and invoke auto source composition and generate autoCheck class file .
- Step 3 node's program downloads autoCheck class file , and instances autoCheck class and invoke measurement tool to get integrity properties of the program, and uses the encrypt methods of autoCheck to encrypt the properties such as file MD5 digests which are to be sent back to the server.
- Step 4 The server uses the same measurement tool and encrypt methods to get the integrity properties from the store



**Fig. 2.** Architecture of DScloud Platform based on Semantic P2P Networks

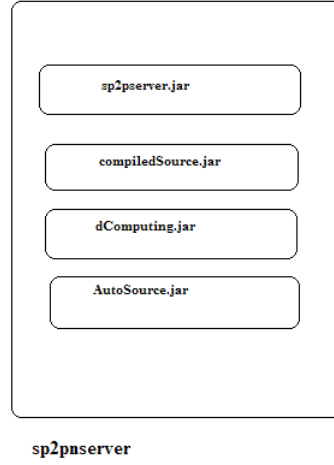
files such as sp2pen.jar, and compares these values with the received ones.

Step 5 if the values are the same, then records that the node is pass, otherwise, it is fail and the node is prohibited to get the next functions. In the meantime, send the check status to the node.

Step 6 if the status the node received is pass, it will continue to run, otherwise, it stops.

## 5 The Analysis of Integrity Check against Attackers

In sp2pen.jar, the code point for the process for integrity check sends autoCheck message and invokes the downloaded autoCheck class and get the returned status of integrity. Due to the JAVA's easy decompiling, the attackers can bypass these steps and go to the next steps. However, these steps are necessary to the server because the server records this node's integrity status; that is, if these steps are



**Fig. 3.** The components of the DScloud platform Server

removed, then server will not let the node program work further because there are vital necessary classes which are downloaded from server.

The autoCheck class which server generated includes measure tools and encrypt methods and inner socket communications. Because this autoCheck class is generated for the request of node, each node's request will generate different autoCheck class. The attackers can not cheat the server because the attackers can not know the just-in-time measure tools and encrypt methods.

There are many measure tools, but the MD5 digest is easy. We can calculate the value of sp2pen.jar with the slight modification of MD5 digest algorithm, and encrypt and sends the values to the server, the server uses the same measure tools and encrypt methods to get the values against the sp2pen.jar file stored in the server.

## 6 Conclusion

This paper presents a Integrity Checker of JAVA P2P distributed system with just-in-time auto source code composition. Integrity of program itself and the system components of JAVA virtual machine are vital important for JAVA P2P distributed systems against attackers, hackers, spies, cheaters conspirators, etc. We here present a novel method using just-in-time auto source code composition to generate just-in-time integrity measure tools and encrypts of integrity reporting. We also analyze integrity guarantees against various kinds of attackers. By

the effort of Hangzhou Domain Zones Technology Co., Ltd. and Domain Search Networking Technology Co., Ltd. , we have implemented and use it in DSCloud platform.

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